

Application Number 10/823,483
Amendment dated MMM DD, 2005
Response to Office Action mailed February 17, 2006

Remarks/Arguments

The Claims Rejection Under 35 USC §103 (a)

The Claims 1-14 stand rejected under 35 USC §103 (a). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. In the following paragraphs, Applicant believes that Examiner has not made such a case, and has responded to each of Examiner's rejections individually to argue that the present invention is not obvious.

Item 5. Claims 1-7 stand rejected under 35 USC §103 (a), Examiner asserting that the present invention is unpatentable over Shakouri et al. (Shakouri)(US Patent No. 5,955,772) and DiMatteo (US Patent No. 6,232,546). According to the Examiner, Shakouri teaches a vacuum thermionic heat pump with a cathode and anode spaced from each other across a vacuum and an external circuit with a power source, and DiMatteo teaches a capacitor sensors and piezoelectric actuators are used to position the electrodes in a thermal energy transfer device. Examiner asserts that it would be obvious to a person of ordinary skill in the art at the time of the invention to construct the heat pump of Shakouri with the actuator of DiMatteo to selectively control the space/energy transfer between the panels as taught by DiMatteo.

First, what suggestion or motivation is there to combine the reference teachings? Whilst DiMatteo discloses systems for maintaining a microcavity over a macroscale area and discloses the use of flexures 20 for achieving and maintaining a sub-micron gap, Shakouri does not teach that active positioning of the electrodes is at all important for improved functionality of heterostructure thermionic coolers. In other words DiMatteo discloses a solution to a problem that Shakouri's invention does not present (namely maintaining a sub-micron gap) and thus the references themselves do not suggest or motivate to combine the reference teachings.

Furthermore, Examiner has not presented any argument or evidence that knowledge generally

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available to one of ordinary skill in the art teaches or motivates the combination of the two references.

Secondly, what is the expectation of success for combining the reference teachings? In general Shakouri teaches a first semiconductor layer separated from a heat sink by a barrier layer, the barrier layer being some kind of solid material able to separate the first semiconductor layer from the heat sink, and though which charge carriers may pass. In a further embodiment, a second semiconductor layer may be present between the heat sink and the barrier layer. In a yet further embodiment (disclosed in Fig. 3E and col 7, lns 23 – 35), Shakouri teaches that *part* of the barrier layer 14 may be removed to form a physical gap 14A, which may be evacuated. It is to be supposed that *if* the teaching of DiMatteo were to be used to modify the teachings of Shakouri, then it is relation to this last embodiment – however it is not clear how the flexures 20 of DiMatteo could be successfully used in the fixed-gap device of Shakouri shown in Fig. 3E. In fact, further complex modifications would be required in order to combine Shakouri and DiMatteo in the manner suggested with no expectation of success.

Applicant respectfully asserts, therefore, that Examiner has not made a *prima facie* case for obviousness, there being no motivation or teaching to combine, nor a reasonable expectation of success, and respectfully requests that rejection of claims 1-7 under 35 USC §103 (a) be withdrawn.

Item 6. Claims 8 and 9 stand rejected as being unpatentable over Shakouri et al. (US Pat. No. 5955772) and DiMatteo (US Pat. No. 6232546), in further view of Richards (US Pat. No. 4281280). Examiner states that Shakouri and DiMatteo teach every aspect of the invention except the inert gas argon between the electrodes. Examiner asserts that because Richards teaches that the vacuum or argon allows the transportation of electrons from the cathode to the anode, it is within the ordinary skill in the art to construct the machine of Shakouri and DiMatteo in view of Richards, thus rendering the present invention unpatentable.

In light of comments made above in relation to Item 5, it follows that the combination of Shakouri and DiMatteo in view of Richards would also not inform the construction of the present

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invention nor render Claims 8-9 as unpatentable. Therefore, Applicant requests withdrawal of the rejection of Claims 8 and 9.

Item 7. Claims 10-14 stand rejected under 35 U.S.C. §103 (a) as being unpatentable over Shakouri et al. (Shakouri) (US Patent No. 5,955,772) and DiMatteo (US Patent No. 6,232,546), and Huffman ("Preliminary Investigations of a Thermotunnel Converter"). Examiner states that Shakouri and DiMatteo teach every aspect of the present invention except the electrons tunneling between the emitter and collector, and the spacing being within 200 angstroms (Claims 11-14) and asserts that Huffman teaches the closing spaced electrodes cause a qualitative increase in the operation of thermionic devices, such as 10 angstroms. Examiner therefore asserts that it would have been obvious to a person of ordinary skill in the art at the time of the present invention to construct the heat pump of Shakouri and DiMattero with the spacing of 10 angstroms, causing tunneling to improve the qualitative operation of the device as taught by Huffman.

In light of comments made above in relation to Item 5, it follows that the combination Huffman, Shakouri and DiMatteon would also be insufficient to render Claims 10-14 as unpatentable.

Furthermore, Applicant respectfully draws the Examiner's attention to the background of the present invention in which Huffman's paper "Preliminary Investigations of a Thermotunnel Converter" is cited at paragraph [0017]. Applicant acknowledges Huffman's thermotunnel converter concept and points out its shortcoming, which the present invention aims to solve. Huffman states (page 574, under the heading 'Technical Approach', 5th line):

'Attempts to mechanically space electrodes at Thermo Electron at distance less than 0.001cm have proven unsuccessful. However, experiments with graphite intercalation compounds have demonstrated that it is possible to chemically space graphite layers to dimensions required for the TTC (ie.order of 10.4) with a number of substances.'

As disclosed, the present invention addresses this shortcoming by utilizing one or more relevant actuating elements to control the separation of the electrodes so that thermotunneling between them occurs. The present invention also comprises a solution to a further shortcoming of the devices described by Huffman (see paragraph [0018]). Therefore, Applicant maintains that

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neither the combination of Shakouri and DiMatteo (as disclosed above), nor the further combination of Huffman would render the present invention as obvious and unpatentable and respectfully requests withdrawal of the rejection of Claims 10-14.

Applicant respectfully submits that this application is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing the application with the Applicant over the telephone might advance prosecution, Applicant would welcome the opportunity to do so.

Respectfully submitted,


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Inventor